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west virginia department of environmental protection

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Office of Oil and Gas  
601 57th Street SE  
Charleston, WV 25304  
(304) 926-0450  
(304) 926-0452 fax

Earl Ray Tomblin, Governor  
Randy C. Huffman, Cabinet Secretary  
www.dep.wv.gov

**PERMIT MODIFICATION APPROVAL**

April 22, 2016

EQT PRODUCTION COMPANY  
120 PROFESSIONAL PLACE  
BRIDGEPORT, WV 26330

Re: Permit Modification Approval for API Number 8510222, Well #: 514474

**Change in Vertical Depth**

Oil and Gas Operator:

The Office of Oil and Gas has reviewed the attached permit modification for the above referenced permit. The attached modification has been approved and well work may begin. Please be reminded that the oil and gas inspector is to be notified twenty-four (24) hours before permitted well work is commenced.

Please call James Martin at 304-926-0499, extension 1654 if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Gene Smith", with a horizontal line underneath.

Gene Smith  
Assistant Chief of Permitting  
Office of Oil and Gas



March 8, 2016

Ms. Laura Adkins  
West Virginia Department of Environmental Protection  
Office of Oil and Gas  
601 57th Street SE  
Charleston, WV 25304

4708510222 MSD

Re: Modification of 47-085-10222 (514474)

Dear Mr. Smith,

Enclosed is an updated WW-6B, schematics, plat and Rec plan. EQT would like to change the vertical depth of this well from Onondaga (6424') to Marcellus (6297'). The top hole, bottom hole, LP and casing plan has not changed.

If you have any questions, please do not hesitate to contact me at (304) 848-0076.

Sincerely,

Vicki Roark  
Permitting Supervisor-WV

Enc.

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STATE OF WEST VIRGINIA  
DEPARTMENT OF ENVIRONMENTAL PROTECTION, OFFICE OF OIL AND GAS  
WELL WORK PERMIT APPLICATION

1) Well Operator: EQT Production Company 306686 Ritchie Clay Pennsboro  
Operator ID County District Quadrangle

2) Operator's Well Number: 514474 Well Pad Name: PEN54

3) Farm Name/Surface Owner: Jerry Morton et al Public Road Access: Rt 50

4) Elevation, current ground: 1016' Elevation, proposed post-construction: 1016'

5) Well Type (a) Gas  Oil \_\_\_\_\_ Underground Storage \_\_\_\_\_

Other \_\_\_\_\_

(b) If Gas Shallow  Deep \_\_\_\_\_

Horizontal

6) Existing Pad: Yes or No No

7) Proposed Target Formation(s), Depth(s), Anticipated Thickness and Expected Pressure(s):  
Marcellus, 6297', 49', 2190 PSI

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8) Proposed Total Vertical Depth: 6297

9) Formation at Total Vertical Depth: Marcellus

10) Proposed Total Measured Depth: 10115

11) Proposed Horizontal Leg Length: 3460

12) Approximate Fresh Water Strata Depths: 99,105,302,627,770

13) Method to Determine Fresh Water Depths: By offset wells

14) Approximate Saltwater Depths: 1350

15) Approximate Coal Seam Depths: 326,789,867,1078,1182

16) Approximate Depth to Possible Void (coal mine, karst, other): None reported

17) Does Proposed well location contain coal seams directly overlying or adjacent to an active mine? Yes \_\_\_\_\_ No

(a) If Yes, provide Mine Info: Name: \_\_\_\_\_  
Depth: \_\_\_\_\_  
Seam: \_\_\_\_\_  
Owner: \_\_\_\_\_

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18)

**CASING AND TUBING PROGRAM**

TYPE	Size (in)	New or Used	Grade	Weight per ft. (lb/ft)	FOOTAGE: For Drilling (ft)	INTERVALS: Left in Well (ft)	CEMENT: Fill-up (Cu. Ft.)/CTS
Conductor	20	New	A-500	78.6	40	40	60 ft <sup>3</sup> / CTS
Fresh Water	13 3/8	New	J-55	54.5	900	900	793 ft <sup>3</sup> / CTS
Coal							
Intermediate	9 5/8	New	P-110	40	5176	5176	2037 ft <sup>3</sup> / CTS
Production	5 1/2	New	P-110	20	10115	10115	TOC is 500' above top producing zone
Tubing	2 3/8		J-55	4.7		May not be run, if run set 40' above top perf or 80° inclination.	
Liners							

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TYPE	Size (in)	Wellbore Diameter (in)	Wall Thickness (in)	Burst Pressure (psi)	Anticipated Max. Internal Pressure (psi)	Cement Type	Cement Yield (cu. ft./k)
Conductor	20	26	.375	1378	1102	Class A	1.18
Fresh Water	13 3/8	17 1/2	.38	2700	2160	See Variance	1.19
Coal							
Intermediate	9 5/8	12 3/8	.395	7900	6320	See Variance	1.19
Production	5 1/2	8 1/2	.361	12640	10112	Class H	1.07/1.86
Tubing	2 3/8	NA	.19	7700			
Liners							

**PACKERS**

Kind:	n/a			
Sizes:	n/a			
Depths Set:	n/a			

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19) Describe proposed well work, including the drilling and plugging back of any pilot hole:

Drill and complete a new horizontal well in the Marcellus Formation. Drill the vertical to an approximate depth of 5250'. Kick off and drill curve. Drill the lateral in the Marcellus. Cement casing.

20) Describe fracturing/stimulating methods in detail, including anticipated max pressure and max rate:

Hydraulic fracturing is completed in accordance with state regulations using water recycled from previously fractured wells and obtained from freshwater sources. This water is mixed with sand and a small percentage (less than 0.3%) of chemicals (including 15% Hydrochloric acid, gelling agent, gel breaker, friction reducer, biocide, and scale inhibitor), referred to in the industry as a "slickwater" completion. Maximum anticipated internal casing pressure is expected to be approximately 10000 psi, maximum anticipated treating rates are expected to average approximately 100 bpm. Stage lengths vary from 150 to 300 feet. Average approximately 200,000 barrels of water per stage. Sand sizes vary from 100 mesh to 20/40 mesh. Average approximately 200,000 pounds of sand per stage.

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21) Total Area to be disturbed, including roads, stockpile area, pits, etc., (acres): 52.03

22) Area to be disturbed for well pad only, less access road (acres): 21.5

23) Describe centralizer placement for each casing string:

- Surface: Bow spring centralizers – One at the shoe and one spaced every 500'.
- Intermediate: Bow spring centralizers– One at the shoe and one spaced every 500'.
- Production: One solid body centralizer spaced every joint from production casing shoe to KOP

24) Describe all cement additives associated with each cement type:

Conductor: Class A no additives  
 Surface (Type 1 Cement): 0-3% Calcium Chloride Used to speed the setting of cement slurries.  
 Intermediate (Type 1 Cement): 0-3% Calcium Chloride. Used to speed the setting of cement slurries.  
 Production: Lead (Type H Cement): 0.2% CD-20 (dispersant makes cement easier to mix). .15% SuperFL-300 (fluid loss/lengthens thickening time) .15% SEC-10 (fluid loss) 50:50 POZ (extender)  
 Tail (Type H Cement): 0.2% Super CR-1 (Retarder). Lengthens thickening time. .3% Super FL-200 (fluid loss) .2% SEC-10 (Fluid loss). .2% SuperFL-350 (fluid loss)  
 Reduces amount of water lost to formation. 60 % Calcium Carbonate. Acid solubility.

25) Proposed borehole conditioning procedures:

Surface: Circulate hole clean while rotating & reciprocating the drill string until cuttings diminish at surface.  
 Intermediate: Circulate hole clean while rotating & reciprocating the drill string until cuttings diminish at surface.  
 Production: Pump marker sweep with nut plug to determine actual hole washout. Calculate a gauge holes bottoms up volume. Perform a cleanup cycle by pumping 3-5 bottoms up or until the shakers are clean. Check volume of cuttings coming across the shakers every 15 minutes.

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\*Note: Attach additional sheets as needed.

Well 514474(PEN54H1)

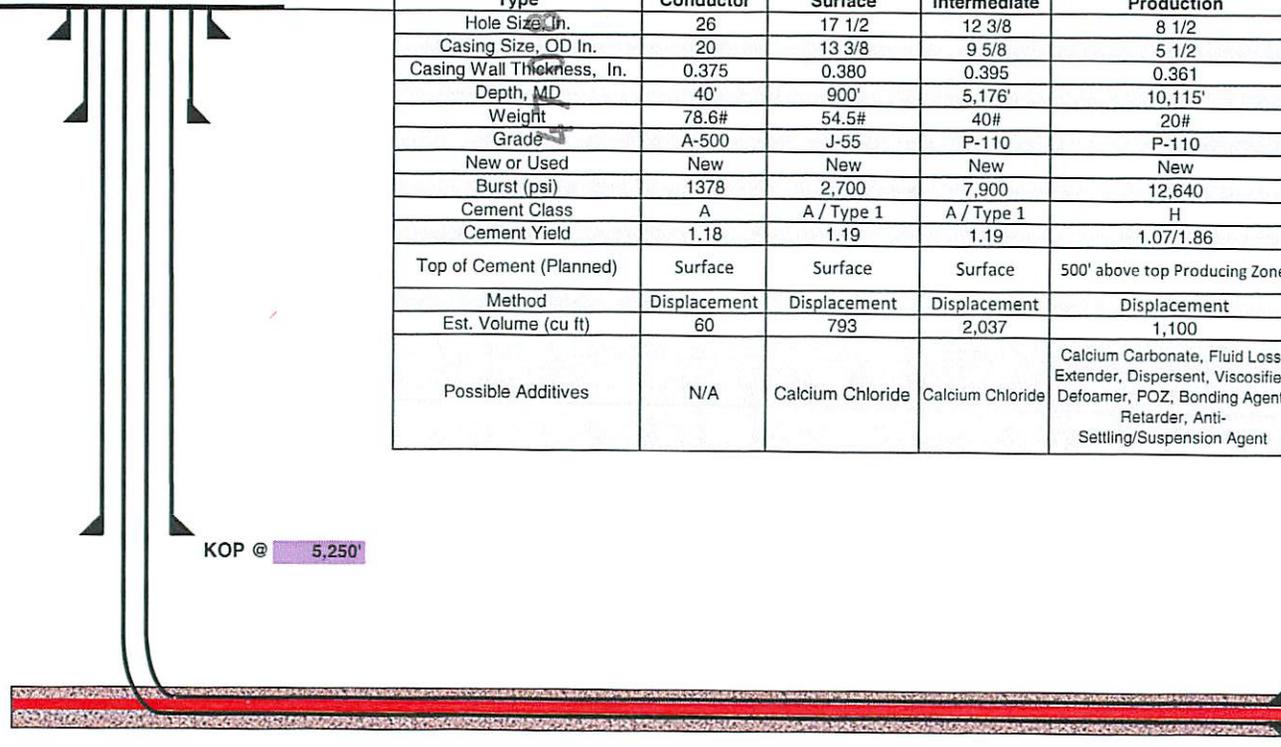
EQT Production  
Pennsboro Quad Quad  
Ritchie County, WV

Azimuth 342  
Vertical Section 3932

Note: Diagram is not to scale

Formations	Top TVD	Base TVD
Conductor	40	
Base Fresh Water	770	
Surface Casing	900	
Base Red Rock	1163	
Maxton	1660 - 1774	
Big Lime	1867 - 2007	
Weir	2262 - 2366	
Gantz	2474 - 2821	
Fifty foot	2616 - 2636	
Thirty foot	2679 - 2703	
Gordon	2726 - 2766	
Forth Sand	2816 - 2827	
Bayard	2947 - 3350	
Warren	3350 - 3417	
Speechley	3429 - 3486	
Balltown A	3949 - 3988	
Riley	4469 - 4514	
Benson	4982 - 5023	
Alexander	5102 - 5126	
Intermediate Casing	5176	
Sonyea	6016 - 6119	
Middlesex	6119 - 6175	
Genesee	6175 - 6224	
Genesee	6224 - 6254	
Tully	6254 - 6269	
Hamilton	6269 - 6275	
Marcellus	6275 - 6324	
Production Casing	10115 MD	
Onondaga	6324	

Casing and Cementing		Deepest Fresh Water: 770'		
Type	Conductor	Surface	Intermediate	Production
Hole Size, In.	26	17 1/2	12 3/8	8 1/2
Casing Size, OD In.	20	13 3/8	9 5/8	5 1/2
Casing Wall Thickness, In.	0.375	0.380	0.395	0.361
Depth, MD	40'	900'	5,176'	10,115'
Weight	78.6#	54.5#	40#	20#
Grade	A-500	J-55	P-110	P-110
New or Used	New	New	New	New
Burst (psi)	1378	2,700	7,900	12,640
Cement Class	A	A / Type 1	A / Type 1	H
Cement Yield	1.18	1.19	1.19	1.07/1.86
Top of Cement (Planned)	Surface	Surface	Surface	500' above top Producing Zone
Method	Displacement	Displacement	Displacement	Displacement
Est. Volume (cu ft)	60	793	2,037	1,100
Possible Additives	N/A	Calcium Chloride	Calcium Chloride	Calcium Carbonate, Fluid Loss, Extender, Dispersent, Viscosifier, Defoamer, POZ, Bonding Agent, Retarder, Anti-Settling/Suspension Agent



Land curve @ 6,297' TVD  
6,655' MD

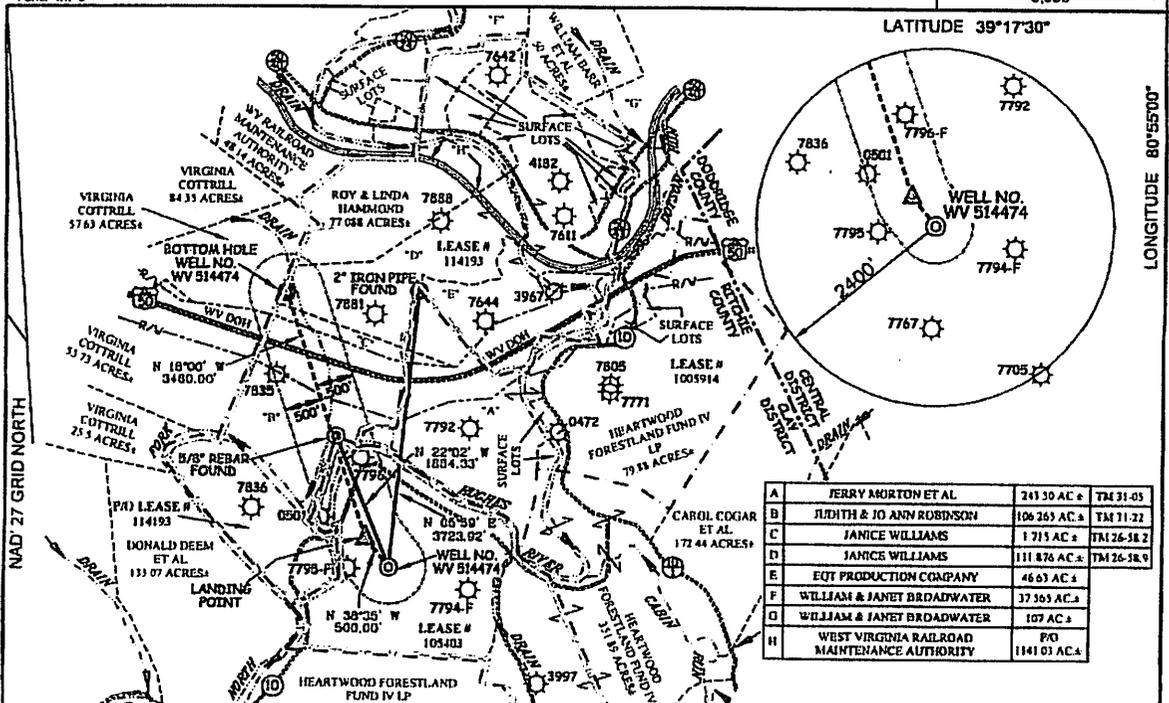
Est. TD @ 6,297' TVD  
10,115' MD

3,460' Lateral

Proposed Well Work:  
Drill and complete a new horizontal well in the Marcellus formation.  
Drill the vertical to an approximate depth of 5250'.  
Kick off and drill curve. Drill lateral in the Marcellus. Cement casing.

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10222 MS



A	JERRY MORTON ET AL	241.30 AC ±	TM 31-03
B	JUDITH & JO ANN ROBINSON	106.265 AC ±	TM 11-22
C	JANICE WILLIAMS	1.715 AC ±	TM 26-38.2
D	JANICE WILLIAMS	111.826 AC ±	TM 26-38.9
E	EQT PRODUCTION COMPANY	46.63 AC ±	
F	WILLIAM & JANET BRADAWATER	37.365 AC ±	
G	WILLIAM & JANET BRADAWATER	107 AC ±	
H	WEST VIRGINIA RAILROAD MAINTENANCE AUTHORITY	P/O 1141.01 AC ±	

**EQT PRODUCTION COMPANY  
FLANAGAN LEASE  
268 ACRES ±  
WELL NO. WV 514474**

(S.P.C. NORTH ZONE) (UTM(M) ZONE 17 NORTH)

NAD27 S.P.C. (FT) N. 279,215.27 E. 1,595,775.03  
 NAD27 GEO. LAT. (N) 39.257703 LONG. (W) 80.927595  
 NAD83 UTM (M) N. 4,345,396.29 E. 508,284.11

**LANDING POINT**

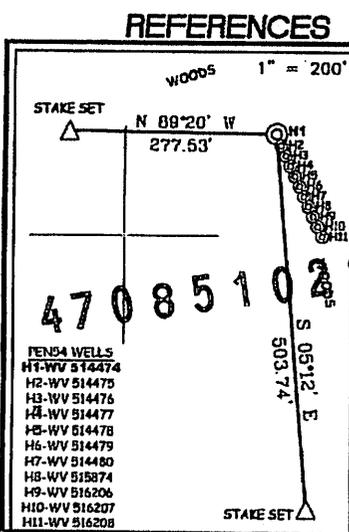
NAD27 S.P.C. (FT) N. 279,608.13 E. 1,595,463.23  
 NAD27 GEO. LAT. (N) 39.258852 LONG. (W) 80.928888  
 NAD83 UTM (M) N. 4,345,513.78 E. 508,167.14

**BOTTOM HOLE**

NAD27 S.P.C. (FT) N. 282,896.79 E. 1,584,394.03  
 NAD27 GEO. LAT. (N) 39.267839 LONG. (W) 80.932648  
 NAD83 UTM (M) N. 4,346,510.83 E. 505,924.67

**LEGEND**

LEASE LINE	---
SURFACE LINE	---
WELL LATERAL	---
OFFSET LINE	---
TIE LINE	---
CREEK	---
ROAD	---
RAIL ROAD	---
COUNTY ROUTE	---
STATE ROUTE	---
PROPOSED WELL	○
EXISTING WELL	○
PERMITTED WELL	○
TAX MAP - PARCEL	TM 00-00

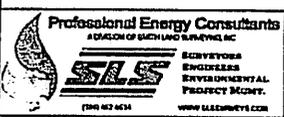


**ROYALTY OWNERS**

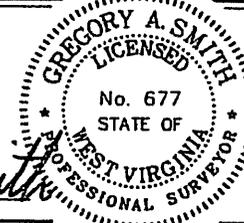
MARY LES AZELMAN GRIS ET AL	800 AC ±	LEASE NO. 114193
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**NOTES ON SURVEY**

1. NO WATER WELLS WERE FOUND WITHIN 250' OF PROPOSED GAS WELL. NO AGRICULTURAL BUILDINGS > 2500 SQ. FT. OR DWELLINGS WERE FOUND WITHIN 625' OF THE CENTER OF PROPOSED WELL PAD.



I THE UNDERSIGNED, HEREBY CERTIFY THAT THIS PLAT IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF AND SHOWS ALL THE INFORMATION REQUIRED BY LAW AND THE REGULATIONS ISSUED AND PRESCRIBED BY THE DIVISION OF ENVIRONMENTAL PROTECTION.



(\*) DENOTES LOCATION OF WELL ON UNITED STATES TOPOGRAPHIC MAPS.

DATE JUNE 1 20 15

REVISED \_\_\_\_\_ 20 \_\_\_\_\_

OPERATORS WELL NO. WV 514474

API WELL NO. 47 - -

STATE COUNTY PERMIT

MINIMUM DEGREE OF ACCURACY 1/200 FILE NO. 8083P514474

HORIZONTAL & VERTICAL CONTROL DETERMINED BY DGPS (SURVEY GRADE TIE TO CORS NETWORK) SCALE 1" = 2000'

STATE OF WEST VIRGINIA  
DIVISION OF ENVIRONMENTAL PROTECTION  
OFFICE OF OIL AND GAS

WELL TYPE: OIL \_\_\_ GAS  LIQUID INJECTION \_\_\_ WASTE DISPOSAL \_\_\_ IF "GAS" PRODUCTION  STORAGE \_\_\_ DEEP \_\_\_ SHALLOW

LOCATION: GROUND PROPOSED

ELEVATION 1,016' 1,016' WATERSHED NORTH FORK HUGHES RIVER

DISTRICT CLAY COUNTY RITCHIE QUADRANGLE PENNSBORO 7.5'

SURFACE OWNER JERRY MORTON ET AL ACREAGE 268.3

ROYALTY OWNER ELLEN S. FRANCAVIGLIA ET AL ACREAGE 268.3

PROPOSED WORK: DRILL  CONVERT \_\_\_ DRILL DEEPER \_\_\_ REDRILL \_\_\_ FRACTURE OR STIMULATE  PLUG AND ABANDON \_\_\_ CLEAN OUT AND REPLUG \_\_\_ OTHER \_\_\_

FORMATION PERFORATE NEW FORMATION \_\_\_ PLUG AND ABANDON \_\_\_ CLEAN OUT AND REPLUG \_\_\_ OTHER \_\_\_

PHYSICAL CHANGE IN WELL (SPECIFY) TARGET FORMATION MARCELLUS ESTIMATED DEPTH 105403

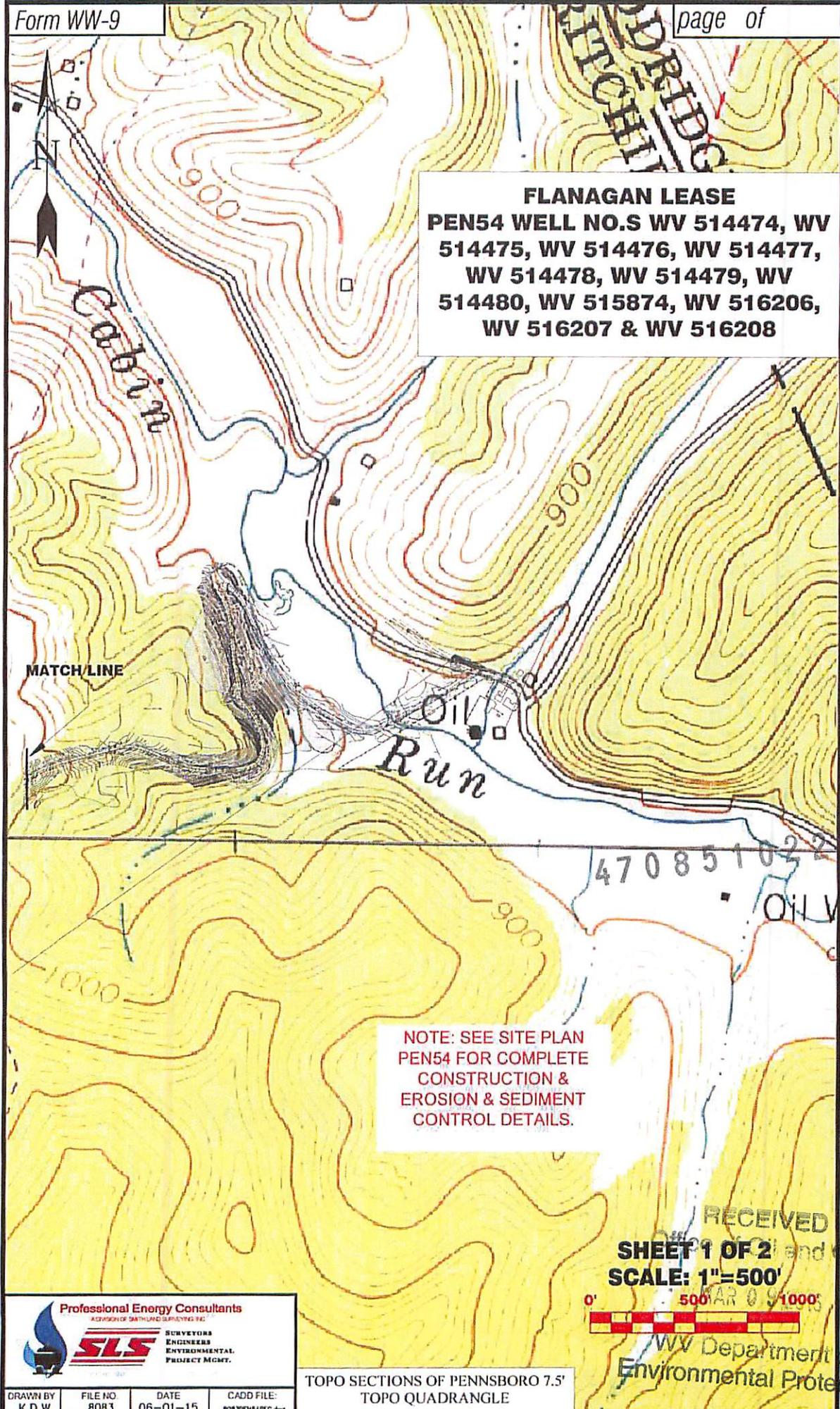
WELL OPERATOR EQT PRODUCTION COMPANY DESIGNATED AGENT REX C. [REDACTED]

ADDRESS 115 PROFESSIONAL PLACE P.O. BOX 280 BRIDGEPORT, WV 26330 ADDRESS 115 PROFESSIONAL PLACE P.O. BOX 280 BRIDGEPORT, WV 26330

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**FLANAGAN LEASE**  
**PEN54 WELL NO.S WV 514474, WV 514475, WV 514476, WV 514477, WV 514478, WV 514479, WV 514480, WV 515874, WV 516206, WV 516207 & WV 516208**

MATCH/LINE

Oil Run

4708510222 MOP

NOTE: SEE SITE PLAN  
 PEN54 FOR COMPLETE  
 CONSTRUCTION &  
 EROSION & SEDIMENT  
 CONTROL DETAILS.

RECEIVED  
 SHEET 1 OF 2 and Gas  
 SCALE: 1"=500'



**Professional Energy Consultants**  
A DIVISION OF SAITHLAND SURVEYING INC.  
  
**SLS**  
 SURVEYORS  
 ENGINEERS  
 ENVIRONMENTAL  
 PROJECT MGMT.

DRAWN BY K.D.W.	FILE NO 8083	DATE 06-01-15	CADD FILE: 808PEN54REC.dwg
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TOPO SECTIONS OF PENNSBORO 7.5'  
 TOPO QUADRANGLE

WV Department of  
 Environmental Protection

4708510222

NOTE: SEE SITE PLAN PEN54 FOR COMPLETE CONSTRUCTION & EROSION & SEDIMENT CONTROL DETAILS.

**FLANAGAN LEASE**  
**PEN54 WELL NO.S WV 514474, WV 514475, WV 514476, WV 514477, WV 514478, WV 514479, WV 514480, WV 515874, WV 516206, WV 516207 & WV 516208**

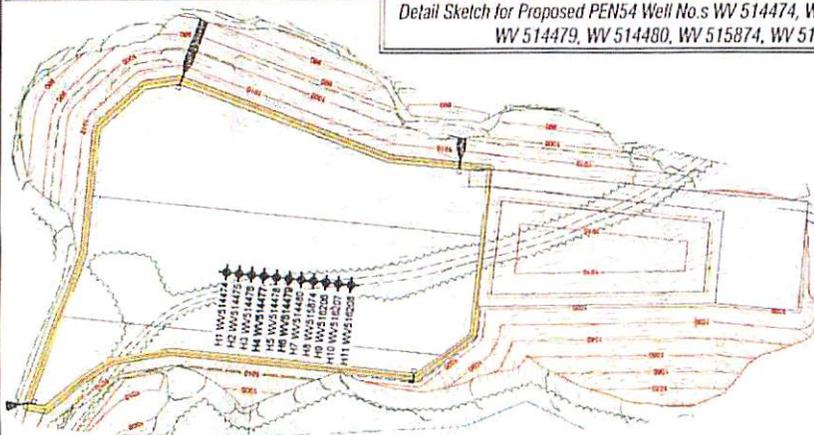
**SHEET 2 OF 2**  
**SCALE: 1"=500'**



MATCH LINE

4708510222 Mod

Detail Sketch for Proposed PEN54 Well No.s WV 514474, WV 514475, WV 514476, WV 514477, WV 514478, WV 514479, WV 514480, WV 515874, WV 516206, WV 516207 & WV 516208



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NOTE: SEE SITE PLAN PEN54 FOR COMPLETE CONSTRUCTION & EROSION & SEDIMENT CONTROL DETAILS.

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TOPO SECTIONS OF PENNSBORO 7.5' TOPO QUADRANGLE

DRAWN BY K.D.W.	FILE NO. 8083	DATE 06-01-15	CADD FILE: 808PEN54PEC.dwg
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Not To Scale

**WEST VIRGINIA GEOLOGICAL PROGNOSIS**

Horizontal Well  
514474(PEN54111)

v 2016.2

514474

**Drilling Objectives:** Marcellus  
**County:** Ritchie  
**Quad:** Pennsboro Quad  
**Elevation:** 1029 KB 1016 GL  
**Surface location** Northing: 279215.27 Easting: 1595775.03  
**Landing Point** Northing: 279606.13 Easting: 1595463.23  
**Toe location** Northing: 282896.79 Easting: 1594394.03  
**Recommended Azimuth** 342 Degrees

TVD: 6297  
 Recommended LP to TD: 3,460'

**Proposed Logging Suite:**

n/a  
 An e-log should be run for the first well on every horizontal well pad.  
 Geologist to recommend when Mudloggers need to be on location to run samples and measure gas thru both the curve and lateral sections.

**Recommended Gas Tests:**

1800, 2050, 2600, Intm Csg. Pt., 3400, 4900, 5250, KOP, (Gas test at any mine void)  
 Gas test during any trip or significant downtime while drilling the lateral section.

**ESTIMATED FORMATION TOPS**

Formation	Top (TVD)	Base (TVD)	Lithology	Comments	Top RR	Base RR
Fresh Water Zone	1	770		FW @ 99,105,302,627,729,745,770.	2	15
Coal	326	334	Coal		10	125
Coal	789	792	Coal	There are no known past, present, or future mining and/or permitting	36	90
Coal	867	872	Coal		50	1078
Coal	1078	1082	Coal		65	220
Coal	1182	1187	Coal		250	270
Maxton	1660	1774	Sandstone	SW @ 1350, ..	254	304
Big Lime	1867	2007	Limestone		289	329
Weir	2262	2366	Sandstone	Storage is NOT of concern	366	420
Top Devonian	2474				419	524
Gantz	2474	2821	Silty Sand		450	570
Fifty foot	2616	2636	Silty Sand		459	504
Thirty foot	2679	2703	Silty Sand		682	693
Gordon	2726	2766	Silty Sand		685	745
Forth Sand	2816	2827	Silty Sand		739	809
Bayard	2947	3350	Silty Sand		790	870
Warren	3350	3417	Silty Sand		864	974
Speechley	3429	3486	Silty Sand		889	959
Balltown A	3949	3988	Silty Sand		890	1060
Riley	4469	4514	Silty Sand		922	1015
Benson	4982	5023	Silty Sand		910	1120 Base of Red
Alexander	5102	5126	Silty Sand	Base of Offset Well Perforations at 5067' TVD		
Int. csg pt	5176					
Elks	5126	6016	Gray Shales and Silts			
Sonyea	6016	6119	Gray shale			
Middlesex	6119	6175	Shale			
Genesee	6175	6224	with black shale			
Genesee	6224	6254	Black Shale			
Tully	6254	6269	Limestone			
Hamilton	6269	6275	calcareous shales			
Marcellus	6275	6324	Black Shale			
Purcell	6287	6293	Limestone			
-Lateral Zone	6297			Start Lateral at 6297'		
Cherry Valley	6307	6311	Limestone			
Onondaga	6324		Limestone			

Target Thickness	49 feet
Max Anticipated Rock Pressure	2190 PSI

**Comments:**  
 Note that this is a TVD prog for a horizontal well (azimuth of 342 degrees; target formation = Marcellus). All measurements taken from estimated KB elevation. Water and coal information estimated from surrounding well data.  
 Intermediate casing point is recommended 50' beneath the Alexander to shut off any water production from the Upper Devonian sands. Intermediate casing should be cemented into the surface string, per WV regulations.  
 The estimated landing point TVD is 6297', rig geologist may adjust landing point. After the well is landed, drill to reported bed dips/ geologists' recommendation. The geologic structure is unknown at this time.

**LATERAL DRILLING TOLERANCES**

**Mapview - Lateral:** Deviate as little as possible to the left or right of the planned wellbore.  
**Mapview - TD:** DO NOT EXTEND beyond recommended wellbore to avoid lease line.

**RECOMMENDED CASING POINTS**

**Fresh Water/Coal** CSG OD 13 3/8 CSG DEPTH: 900  
**Intermediate 1:** CSG OD 9 5/8 CSG DEPTH: 5176  
**Production:** CSG OD 5 1/2 CSG DEPTH: @ TD

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 50' past Alexander porosity  
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